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Automated mineral identification and its applications in rock mechanics

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Microstructural features of a material are determining its mechanical properties. Mechanical properties of rock materials are very important in a wide range of engineering disciplines including mining, civil and petroleum. In order to reliably model mechanical properties of rock materials quantifying their microstructural features is the first step. Rocks are formed from different minerals with different textural features. Optical microscopy is the main method in order to quantify both mineralogical and textural (size, shape, interlocking, …) features of rock materials. However, manual microscopy is a time-consuming process, and a successful rock quantification requires an experienced operator. Therefore, an Automated Mineral Identification (AMI) scheme is highly demanded. For the sake of a successful AMI both colour and textural patterns of the rock forming minerals must be taken into account. Minerals regarding their crystallographic systems are showing different colors under planned and crossed polarized lights as a function of the orientation of their optical axes with the polarizers. These colour variations are the most important colour features for the task of mineral identification. The major rock forming minerals including quartz and feldspars, however, cannot be recognized just by their colour features. These minerals are showing distinct textural features including twinning and undulatory extinction. It will be explained how developed AMI schemes can recognize and classify minerals based on colour and textural features. Moreover, it will be shown that the mechanical properties of rack materials are closely related to their petrographic features, and it is possible to successfully estimate engineering properties of rock materials by means of quantitative analysis of their photomicrographs.

Recent publications

1. Safari Farrokhad, Sajad & Lashkaripour, Gholam Reza & Moghaddas, Naser & Aligholi, Saeed & Sabri, Mohanad. (2022). The Effect of the Petrography, Mineralogy, and Physical Properties of Limestone on Mode I Fracture Toughness under Dry and Saturated Conditions. Applied Sciences. 12. 10.3390/app12189237.

2. Aligholi, Saeed & Khajavi, Reza & Khandelwal, Manoj & Armaghani, Danial. (2022). Mineral Texture Identification Using Local Binary Patterns Equipped with a Classification and Recognition Updating System (CARUS). Sustainability. 14. 11291. 10.3390/su141811291.

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Biography

Saeed Aligholi obtained a B.Sc. in Applied Geology from Shahrood University of Technology, and an M.Sc. in Engineering Geology from Ferdowsi University of Mashhad. His PhD awarded recently by the department of Civil Engineering, Monash University. Dr. Aligholi is currently a sessional lecturer at institute of Innovation, Science and Technology, Federation University Australia. He has worked in the field of automatic microstructural quantification of rock materials by means of image processing and machine learning techniques, and understanding the relationship between physical, mechanical and dynamical properties of rock materials, and has published his findings and contributions in high ranked journals.

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